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(54) ISOLATION PROXY SERVER SYSTEM

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(52) **U.S. Cl.**
CPC ***H04L 63/0281*** (2013.01); ***H04L 67/28*** (2013.01)

(58) **Field of Classification Search**
CPC .. H04L 63/02; H04L 63/0281; H04L 63/0209
See application file for complete search history.

(56) **References Cited**

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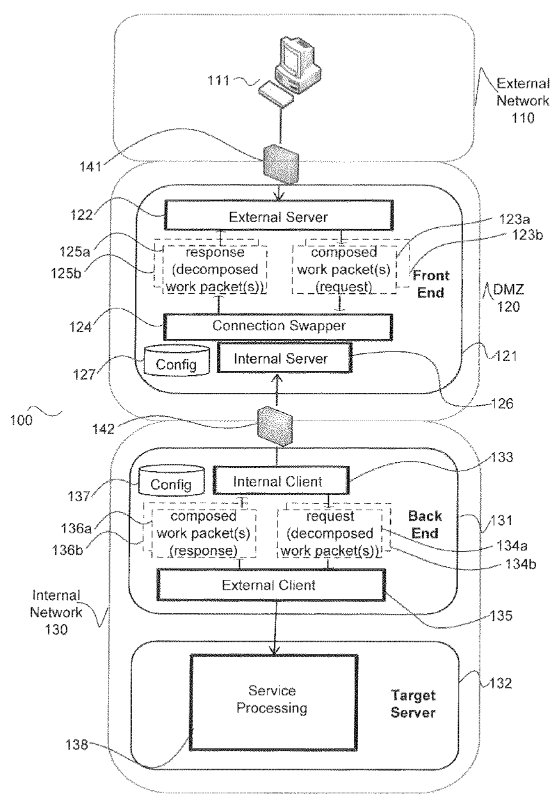
(57) **ABSTRACT**

An isolation proxy server system separates a typical proxy server or reverse proxy server into two physical computing platforms. A first physical platform, a front end proxy server, receives requests from clients on an external network, but is unable to relay requests by originating corresponding requests on an internal network. A second physical platform, a back end proxy client, originates distinct work requests to the front end proxy server. The front end proxy server forwards client requests to the back end proxy client in responses to the distinct work requests it receives from the back proxy client. The back end proxy client relays the client requests to a target server. Thus, the front end proxy server may not originate new requests to the server(s) in the protected zone, and the back end proxy client may not receive new requests from clients or from the front end proxy server.

20 Claims, 3 Drawing Sheets



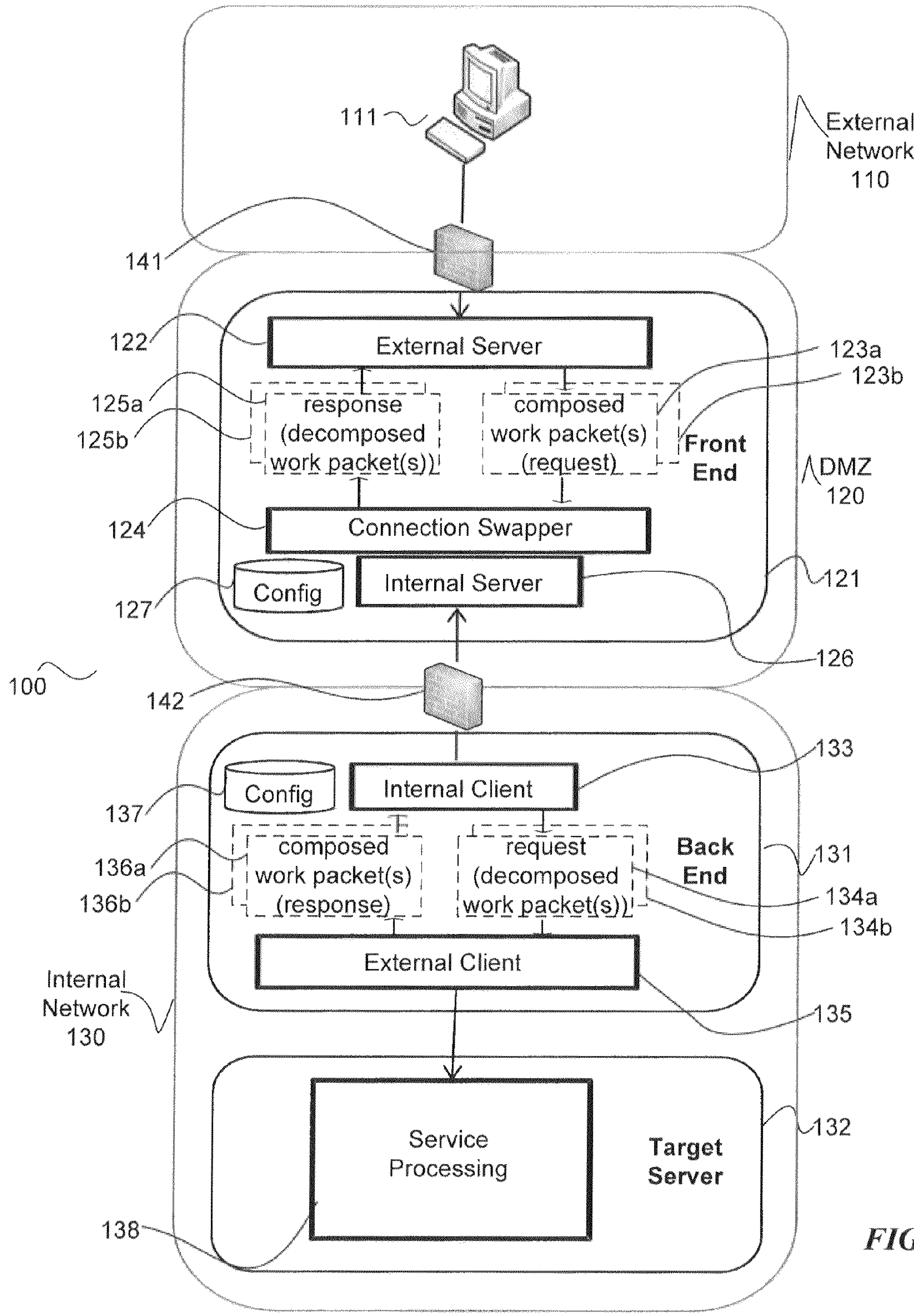

111
External Network 110
141
122
External Server
123a
123b
125a
125b
response (decomposed work packet(s))
composed work packet(s) (request)
Front End
DMZ 120
124
Connection Swapper
Config
Internal Server
121
127
126
100
142
133
Config
Internal Client
137
composed work packet(s) (response)
request (decomposed work packet(s))
Back End
131
136a
136b
134a
134b
Internal Network 130
External Client
135
Service Processing
Target Server
132
138

FIG. 1

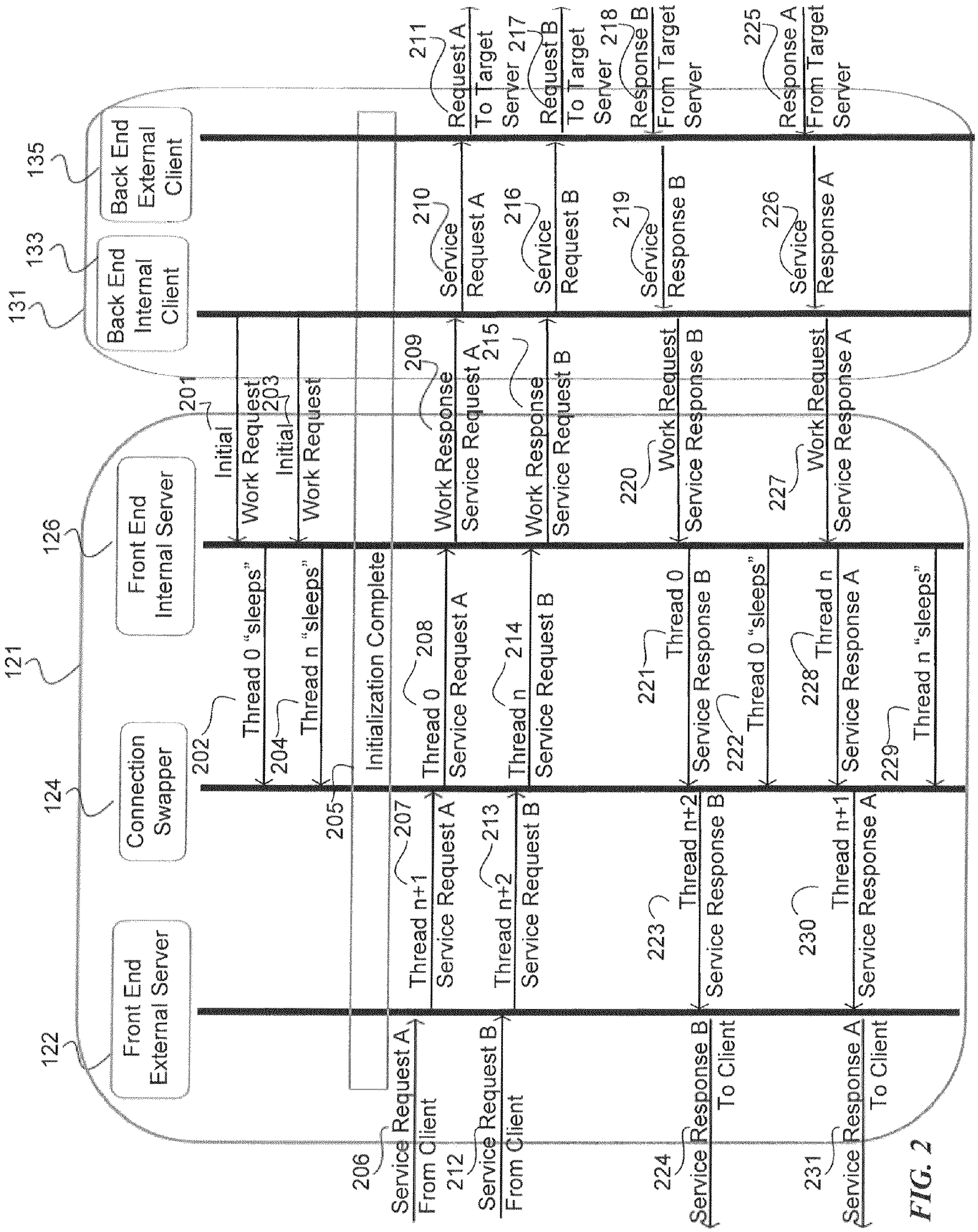

121
122
Front End External Server
124
Connection Swapper
126
Front End Internal Server
131
133
Back End Internal Client
135
Back End External Client
201
Initial Work Request
202
Thread 0 "sleeps"
203
Initial Work Request
204
Thread n "sleeps"
205
Initialization Complete
206
Service Request A From Client
207
Thread n+1 Service Request A
208
Thread 0 Service Request A
209
Work Response Service Request A
210
Service Request A
211
Request A To Target Server
212
Service Request B From Client
213
Thread n+2 Service Request B
214
Thread n Service Request B
215
Work Response Service Request B
216
Service Request B
217
Request B To Target Server
218
Response B From Target Server
219
Service Response B
220
Work Request Service Response B
221
Thread 0 Service Response B
222
Thread 0 "sleeps"
223
Thread n+2 Service Response B
224
Service Response B To Client
225
Response A From Target Server
226
Service Response A
227
Work Request Service Response A
228
Thread n Service Response A
229
Thread n "sleeps"
230
Thread n+1 Service Response A
231
Service Response A To Client

FIG. 2

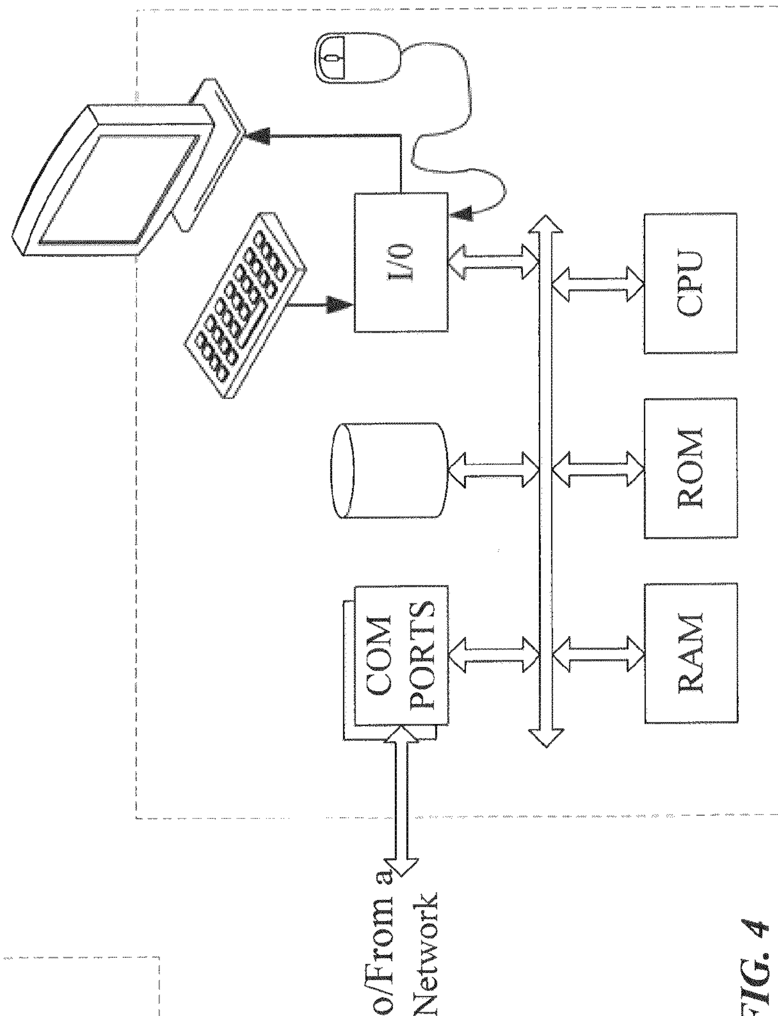

I/0
CPU
ROM
RAM
COM PORTS
To/From a Network

FIG. 4

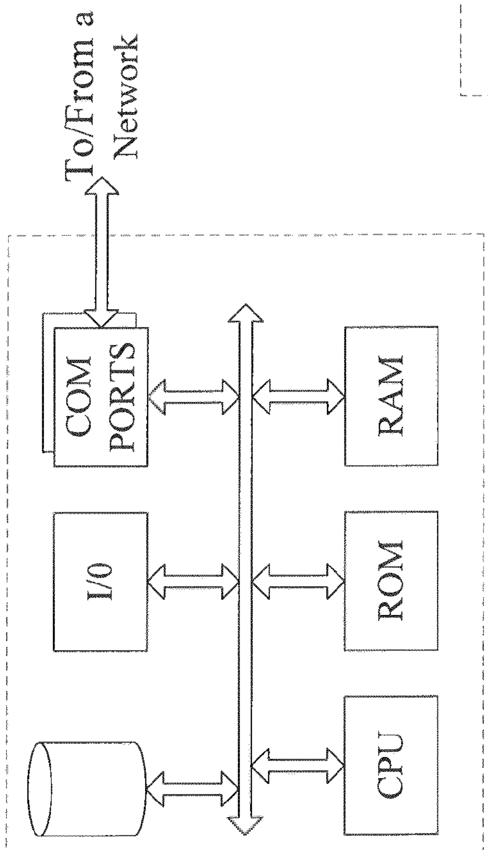

To/From a Network
COM PORTS
I/0
CPU
ROM
RAM

FIG. 3

ISOLATION PROXY SERVER SYSTEM

BACKGROUND

In a client-server computing environment, an end user of a client computing device may initiate a request for a service provided by another computing device acting as a target server. For example, an end user may use a web browser client on a PC to request a web page. The web page may be stored on a web server and delivered to the PC in response to the request. The web browser may then render the received response on the PC for the end user.

In the client-server computing environment described above, the request from the client contains addresses associated with the client and the target server. Likewise, the response contains addresses associated with the client and the target server. In this way, the target server knows where the request came from; and the client knows where the response came from. If the target server becomes compromised by an attacker, however, the attacker may be able to acquire the client's address and direct an attack at the client. In a similar fashion, when the target server's address is publically known, the target server becomes much more susceptible to attack.

A typical proxy server provides enhanced security to clients in a client-server environment by hiding the clients' real addresses behind the address of the proxy server. The proxy server receives requests from the clients for services provided by target servers. The proxy server then relays the requests on behalf of the clients to the corresponding target server as if the requests originated from the proxy server, by replacing each client address with the address of the proxy server. In this way, the requests appear to be from the proxy server, and the corresponding target server is unaware of the individual clients. This allows the clients some protection from attacks originating from the target servers or other sources outside of the proxy server's internal network.

In a similar fashion, a reverse proxy provides protection to one or more target servers by receiving requests from clients on behalf of the target servers. Clients send their requests to the address of the reverse proxy server, which in turn replaces the address of the reverse proxy server with the address of the corresponding target server and relays the request to the corresponding target server. As such, individual addresses of the target servers are not publically known, and the target servers are better protected.

Hence, proxy servers provide protection for clients and reverse proxy servers provide protection for target servers by obscuring the existence of the clients and target servers, respectively. An attacker is unable to attack an unknown victim (client or target server). Proxy servers and reverse proxy servers, however, are vulnerable to attack and, once compromised, may be used by an attacker to reach the clients and target servers that were once obscured. This is possible because typical proxy servers and reverse proxy servers may originate a request to a client or target server, respectively, without receiving a corresponding request from an outside source.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawing figures depict one or more implementations in accord with the present teachings, by way of example only, not by way of limitation. In the figures, like reference numerals refer to the same or similar elements.

FIG. **1** is a high-level functional block diagram of an example of a system of proxy servers that provide proxy services and support an example of a proxy isolation system.

FIG. **2** is a high-level process flow of an example of a process of receiving service requests from a client, mapping front end internal server threads with front end external server threads by a connection swapper, exchanging work requests and work responses between a back end internal client and a front end internal server, and delivering service responses to the client, in a system like that of FIG. **1**.

FIG. **3** is a simplified functional block diagram of a computer that may be configured as a host or server, for example, to function as the front end proxy server in the system of FIG. **1**.

FIG. **4** is a simplified functional block diagram of a personal computer or other work station or terminal device.

DETAILED DESCRIPTION OF EXAMPLES

In the following detailed description, numerous specific details are set forth by way of examples in order to provide a thorough understanding of the relevant teachings. However, it should be apparent that the present teachings may be practiced without such details. In other instances, well known methods, procedures, components, and/or circuitry have been described at a relatively high-level without detail, in order to avoid unnecessarily obscuring aspects of the present teachings.

A need exists for a system that provides proxy services without allowing a front-end proxy server to originate any request.

The various examples disclosed herein relate to an isolation proxy server system that separates a typical proxy server or reverse proxy server into two physical computing platforms. One physical computing platform functions, for example, as a front end proxy server that receives a user request from a user client on an external network, but is unable to relay the user request by originating a corresponding new request on the internal network. The other physical computing platform functions, for example, as a back end proxy client and originates a distinct request from the back end proxy client to the front end proxy server.

The front end proxy server may then, for example, forward the received user request from the user client to the back end proxy client as a response to the distinct request received from the back end proxy client. The back end proxy client then relays the user client request to a target server in a traditional fashion. The target server, for example, processes the user request and returns a response in a traditional fashion to the back end proxy client. The back end proxy client then returns the response from the target server to the front end proxy server, as a new request, and the front end proxy server delivers the response to the user client.

A computer or the like running a server program, for convenience, is often itself referred to as a server, a server computer or a server platform. Conversely, another computer or the like that runs a client program for consuming the particular service offered by a server is often itself referred to as a client, a client computer or a client device.

A server is typically implemented as a server application program running on the computer or other platform that is to be configured to offer the service, whereas the client is typically implemented as a client application program running on the device that is to be configured to consume the service. In many cases, the client applications run on end users' equipment, such as terminals or mobile devices that communication with the computer(s) running the server program, via a network. For some purposes, however, a client and server may run in the same device and/or a device that is a server for one purpose may be a client of another server for some other purpose. For convenience, the description that follows may often use the term server to broadly represent a data processing device used to run the applicable server programming. Such devices typically utilize general purpose computer hardware with appropriate network communication capabilities, to perform server processing and to perform attendant communications via one or more networks. The hardware elements of such server computers may be conventional in nature.

A proxy is a specialized type of server that receives a request form a client and relays the request to an intended target server while replacing the client address with the address of the proxy server, so that the request appears to come from the proxy. A reverse proxy is another specialized type of server that operates in a reverse fashion to a proxy. That is, the reverse proxy receives a response from a target server and relays the response to an intended client while replacing the target server address with the address of the proxy server.

A demilitarized zone (DMZ) is a network segment or segments wherein attacks and malicious traffic from an external network are anticipated and security measures are implemented to minimize the impact of attacks and malicious traffic on an internal network. A network is considered external to an entity or organization when the entity or organization does not have control over the network. A network is considered internal to an entity or organization when the entity or organization does have control over the network. As such, the DMZ functions as a buffer between an external network for which an entity or organization lacks control and an internal network for which an entity or organization has control and desires protection. In addition, server(s) located within the DMZ may be isolated from other server(s) or system(s) in that the DMZ server(s) may only communicate with the other server(s) or system(s) in a predefined fashion and/or in compliance with predefined rules.

Further, a system may have a front end component and a back end component. That is, in a system, users or equipment in an external network may only interact with a front end component. In a similar fashion, servers and/or terminal equipment in an internal network may only interact with a back end component. A DMZ system, then, requires the front end component and the back end component to interact, for example, in order to facilitate communications between end users in the external network and servers in the internal network.

The isolation proxy server system may enhance security, for example, because the front end proxy server may only respond to corresponding requests for resource(s) received from both the external and internal networks, but may not originate any requests. For example, any communication destined for the external network from the front end proxy server must only be in response to a request received from that network. Similarly, any communication destined for the internal network from the front end proxy server must only be in response to a request received from that network. Conversely, the back end proxy client may only originate requests to the front end proxy server and target servers, but may not receive any requests originated from either the external or internal networks. Thus, even if the front end proxy server were compromised, for example, an attacker would not be able to originate an attack.

Reference now is made in detail to the examples illustrated in the accompanying drawings and discussed below. FIG. **1** illustrates an example of the isolation proxy server system **100** including an external network **110**, a DMZ **120**, and an internal network **130**.

The external network **110** may be, for example, the Internet or an intranet. In addition, the external network **110** may be a wide area network (WAN) or a local area network (LAN). The external network **110** may, for example, have at least one client **111**. Client **111** may be, for example, a client computer, such as depicted in FIG. **4** and further described below. The client **111** may connect to the external network **110** via any convenient available wired or wireless network communications technology. Such a wired network communications network technology may be, for example, Ethernet over cable or optical fiber; and such as wireless network communications technology may use, for example, Wi-Fi or cellular data communications.

The internal network **130** may be a LAN or WAN. For example, the internal network **130** may be a LAN located within a data center or some other enterprise facility. The internal network **130** may provide communications for or include, for example, one or more target servers **132**. The target server **132** may be, for example, a host computer platform, such as depicted in FIG. **3** and further described below. The target server **132** may connect to the internal network **130** via wired or wireless network communications media. Such wired network communications may be, for example, Ethernet over cable or optical fiber.

Although DMZ **120** may be a single hardware platform, the DMZ **120** may be a number of hardware devices connected to form or via a network, for example, a LAN or WAN. For example, the DMZ **120** may be a LAN located within the same data center or other enterprise facility as the internal network **130**. Alternatively, the DMZ may be located within a different data center or other enterprise facility than the internal network **130**. The DMZ **120** is intended, for example, to provide a buffer between the external network **110** and the internal network **130**.

The client **111** may, for example, run an application that makes requests for a service intended to ultimately be serviced by the target server **132** located within internal network **130**. The application running on the client **111** may be, for example, a web browser and the target server **132** may, for example, implement service processing **138**. Such service processing **138** may be, for example, a web server. The client's service request may be, for example, an HTTP request. Although the examples below utilize a web browser, web server, and HTTP request, the isolation proxy server system and methodology are not restricted to such application or request. For example, the provided service may be a streaming media service or a file download service. In such alternate examples, the request may be a real time protocol (RTP) or file transfer protocol (FTP) request. In addition, the application running on the client **111** may be a standardized end user application, a customized end user application, or any client-server application that requests a service from the target server **132** and receives a response from the target server **132**.

The isolation proxy server system **100** may further include a front end proxy server **121** located within the DMZ **120** and a back end proxy client **131** located within the internal network **130**. The front end proxy server **121** and the back end proxy client **131** may be, for example, host computer platforms, such as depicted in FIG. **3** running appropriate programming as further described below. The front end proxy server **121** may communicate with or via the network of the DMZ **120** and with the back end proxy client **131** via internal firewall **142**. The back end proxy client **131** may communicate with other elements of the internal network **130**. Such communication may be, for example, via wired or wireless network communications. The wired network communications may be, for example, Ethernet over cable or optical fiber.

The front end proxy server **121** may include an external server **122**, a connection swapper **124**, and an internal server **126**, as described in further detail below. The back end proxy client **131** may include an internal client **133** and an external client **135**, as described in further detail below. The front end proxy server **121** and the back end proxy client **131** each includes a configuration file **127**, **137**. Each configuration file **127**, **137** contains rules that control how the various elements of front end proxy server **121** and back end proxy client **131** interact, as described below.

In the examples, as detailed further below, the external server **122** composes work packet(s) **123***a*, **123***b* that encapsulate request(s) for service from client **111** and decomposes work packet(s) **125***a*, **125***b* to receive encapsulated response(s) to the request(s) for service for sending service response to the client **111**. The external server **122**, for example, composes work packet **123***a* by encapsulating (e.g. embedding) the original request for service from client **111** into a field within work packet **123***a*. In an example, a work packet includes a header for routing information an the like and a body for message content, and the field containing the request for service is the body field within work packet **123***a*. Likewise, external server **122**, for example, decomposes a received work packet **125***a* to recover the encapsulated (e.g. embedded) service response (responsive to a service request) from a field within the received work packet **125***a*. In an example, the field is the body field within work packet **125***a*.

In the back end proxy client **131**, the internal client **133** decomposes work packet(s) **134***a*, **134***b* to receive the encapsulated request(s) for service for relay to the target server **132** and composes work packet(s) **136***a*, **136***b* that encapsulate response(s) to the request(s) for service received from the target server **132**.

In addition, the isolation proxy server system **100** may further include an external firewall **141** and an internal firewall **142**. The external firewall **141**, in the example, is between the DMZ **120** and the external network **110**. The internal firewall **142**, in the example, is between the DMZ **120** and the internal network **130**. In this example, the client **111** communicates via the external network **110** with the front end proxy server **121** via the DMZ **120** only through the external firewall **141**. Further in this example, the front end proxy server **121** communicates via the DMZ **120** with the back end proxy client **131** via the internal network **130** only through the internal firewall **142**.

In the example of FIG. **1**, the external firewall **141** provides protection to the DMZ **120** and the front end proxy server **121** from attacks or malicious traffic originating in the external network **110**. In the illustrated example, the internal firewall **142** provides protection to the internal network **130**, the back end proxy client **131**, and the target server **132** from attacks or malicious traffic also originating in the external network **110** as well as originating in the DMZ **120**.

In one example, the external firewall **141** is configured to only allow requests originating from the external network **110**, such as client **111**, and destined for the front end proxy server **121**. In addition, the external firewall **141** is also configured to only allow responses from the front end proxy server **121** to the external network **110** that correlate to existing requests from the external network **110**. As is common in most firewalls, external firewall **141** and internal firewall **142** correlate existing requests and responses by maintaining a table and/or database of parameters related to each request and each response (e.g. source and/or destination IP address, source and/or destination IP port, etc.). In this example, the external firewall **141** blocks any request from the external network **110** that is not destined for the front end proxy server **121**. Also in this example, the external firewall **141** blocks any response from the front end proxy server **121** to the external network **110** that does not correlate to an existing request from the external network **110**. Further in this example, the external firewall **141** also blocks any request from the front end proxy server **121**.

In a similar example, the internal firewall **142** is configured to only allow requests originating from the back end proxy client **131** located within the internal network **130** and destined for the front end proxy server **121**. In addition, the internal firewall **142** is also configured to only allow responses from the front end proxy server **121** to the back end proxy client **131** located within the internal network **130** that correlate to existing requests from the back end proxy client **131**. That is, for example, the front end proxy server **121** only receives requests from the back end proxy client **131** and generates responses to the back end proxy client **131** that correlate to those existing requests. At the same time, in this example, the front end proxy server **121** will not originate any new requests (e.g. front end proxy server **121** can communicate in response to requests from, but cannot originate any new communication with, back end proxy client **131**). Likewise, in this example, the back end proxy client **131** will only generate new requests to the front end proxy server **121** and receive responses from the front end proxy server **121** that correlated to those existing requests. Further in this example, the back end proxy client **131** does not receive any new requests.

The isolation proxy server system **100**, when configured as described in the previous examples, isolates the internal network **130** by eliminating the need and/or ability of the internal network **130** to receive any request from the external network **110** and/or the DMZ **120**. In addition, the isolation proxy server system **100** provides additional security, for example, by translating or replacing the address of the target server **132** with the address of the front end proxy server **121** in responses sent out through the external network **110**. Such address translation occurs, for example, in external firewall **141**, internal firewall **142**, front end proxy server **121**, and/or back end proxy client **131**.

Although FIG. **1** and the corresponding description above illustrate a single client **111**, a single front end proxy server **121**, a single back end proxy client **131**, a single external firewall **141**, a single internal firewall **142**, an a single target server **132**, this is only for simplicity in describing the isolation proxy server system **100**. The isolation proxy server system **100** may include and/or communicate with more than one or each of these elements without changing the behavior of the isolation proxy server system **100**.

For example, one or more front end proxy servers **121** may receive multiple request for multiple services provided by one or more target servers **132**. In this example, each request may come from the same client **111** or different clients **111**. The same client **111**, for example, may send all requests to the same front end proxy server **121** or may send each request to a different front end proxy server **121**. In addition, each front end proxy server **121**, for example, may send all requests to the same back end proxy client **131** or may send each request to a different back end proxy client **131**. Each back end proxy client **131**, for example, may also send all requests to the same target server **132** or may send various requests to different target servers **132**.

Typically, in such an example, each response is only returned to the source of each respective request. For example, the target server **132** would only return a response to the back end proxy client **131** from which the target server **132** received the respective request. In a similar fashion, the front end proxy server **121** would only send a response to the same back end proxy client **131** or the same user client **111** from which the front end proxy server **123** received the respective request.

With further reference to FIG. **1**, the elements of the front end proxy server **121** and the back end proxy client **131** will now be described in relation to the flow of a request for a service from the client **111** to the target server **132** providing the service as well as a corresponding response to the request for the service from the target server **132** to the client **111**.

In the examples, a request for a service, or service request as referred to in FIG. **2**, is a specific request from a client application to a target server to perform the specific service. Likewise, a response to the request for the service, or service response as referred to in FIG. **2**, is a specific response from the target server containing the results of the target server performing the specific service.

In contrast, a request for work, or work request as referred to in FIG. **2**, is a general request by a first element for work that needs to be performed from a second element within the isolation proxy server system **100**. For example, the back end proxy client internal client **133** requests work from the front end proxy server internal server **126**, as described further below. Similarly, a response to the work request, or work response as referred to in FIG. **2**, is a general response by the second element to the first element containing the work to be performed. Continuing the example, the front end proxy server **126** responds to the work request form the back end proxy client internal client **133** with a composed work packet **123***a*, as described further below. In the examples, the composed work packet **123***a* encapsulates the service request from the client **111**. As such, the work response contains the service request.

In the isolation proxy server system **100**, as described in detail below, a work request may also contain work performed in response to a previously work response. Returning to the previous example, when the back end proxy client internal client **133** requests work from the front end proxy server internal server **126**, the work request also contains a composed work packet **136***a*, as described further below. In the examples, the composed work packet **136***a* encapsulates a service response to a previous service request. As such, the work request may also contain a service response to a previous service request. That is, a work request is both a general request for work to be performed (e.g. a service request) as well as a specific response containing performed work (e.g. a service response).

FIG. **2** depicts the flow of request(s) for a service and response(s) to the request(s) for a service as well as the flow of work response(s) and work request(s) within the isolation proxy server system **100** in further detail. In the examples, configuration file **137** of the back end proxy client **131** contains one or more rules that allow or deny the back end proxy client internal client **133** to send work requests to or receive work responses from the front end proxy server internal server **126**. Additionally, configuration file **137** of the back end proxy client **131** contains, for example, one or more rules that allow or deny the back end proxy client external client **135** to send service requests to or receive service responses from target server **132**. Similarly, configuration file **127** of the front end proxy server **121** contains one or more rules that allow or deny the front end proxy server internal server **126** to receive requests for work from or send responses to requests for work to the back end proxy client internal client **133**. A number of the steps shown in FIG. **2** may be regulated by one or more rules in these configuration files **127**, **137**.

The isolation proxy server system **100** is initialized when the back end proxy client internal client **133** submits one or more initial request(s) for work **201**, **203** to the front end proxy server internal server **126**, as depicted in FIG. **2**. For example, when the back end proxy client **131** is powered on or otherwise booted-up and the back end proxy client internal client **133** is launched, the back end proxy client internal client **133** will submit initial request(s) for work at **201**, **203** to the front end proxy server internal server **126**. Two initial work requests are shown by way of example. The back end proxy client internal client **133** may, based on configuration file **137**, submit more than two initial work requests in order to improve performance. Each of the initial request(s) for work in steps **201**, **203** may be, for example, an HTTP request. In this example, the front end proxy server internal server **126** is not able to perform any work until receipt of one or more initial request(s) for work from the front end proxy server internal client **133**.

Each initial request for work prompts the front end proxy server internal server **126** to generate a corresponding initial internal thread of execution. Thread 0 and Thread n at steps **202**, **204**. More threads may be opened if the server receives more work requests before it processes requests and sends responses. A thread of execution is the smallest independently manageable sequence of programmed instructions. The front end proxy server **121** is, for example, a program. The external server **122**, connection swapper **124**, and internal server **126** are each, for example, program objects within the front end proxy server **121** program. A process within a computing platform, such as the front end proxy server **121**, may contain multiple threads of execution which share memory and resources within the process. Program objects within a program, such as external server **122** and internal server **126**, generate threads of execution. An additional program object, such as connection swapper **124**, may exchange data between threads of execution generated by one program object, e.g. external server **122**, and threads of execution generated by another program object, e.g. internal server **126**. Such exchange of data by the front end proxy server connection swapper **124** is described in further detail below.

Once the initial request(s) for work are submitted in **201**, **203** and the corresponding initial internal threads of execution are established at steps **202**, **204**, initialization is complete **205**. Once initialization is complete, the back end proxy client internal client **133** awaits a response to the initial request(s) for work and the initial internal threads of execution sleep until the front end proxy server connection swapper **124** is ready to exchange data with the internal threads of execution.

At this point in the process example of FIG. **2**, the front end proxy server external server **122** may, for example, receive a request A for the service provided by the target server **132** from the client **111** at step **206**. For purposes of an example to consider here, we will assume that the client **111** requests a web page stored on the target server **132**. Receipt of such a service request prompts the front end proxy server external server **122** to compose a work packet **123***a* by encapsulating the received service request A as part of step **207**.

The composed work packet **123***a* contains, for example, a unique ID and work package version number. In an example, over time, the work packet format may be changed. Each work packet format, in this example, has a new version number assigned. As such, the work packet version number defines, for example, which version or format of work packet is currently being implemented. The composed work packet **123***a* also contains a mode indicating the contents of the composed work packet **123***a*. The mode may be, for example, one of: empty, request, response, keepalive, heartbeat, or DirectData. A keepalive work packet, for example, is exchanged to maintain an existing session between the front end proxy server **121** and back end proxy client **131**. A heart-beat work packet, for example, is sent from one element (e.g. the front end proxy server **121**) to the other element (e.g. the back end proxy client **131**) to determine if the other element is still functioning. In some examples, the front end proxy server **121** and the back end proxy client **131** need to exchange information unrelated to a specific service request or response, in which case a DirectData work packet is used. The composed work packet **123***a* also contains various properties from the received client request including the target URL, HTTP method, HTTP headers and parameters, as well as the service request itself.

In the example of FIG. **2**, the front end proxy server external server **122** then generates a new external thread of execution, Thread n+1 on the external side of the front end proxy server connection swapper **124** (at step **207**), based on service request A received from client **111**; and front end proxy server external server **122** submits a composed work packet **123***a* to the front end proxy server connection swapper **124** via that Thread n+1. The front end proxy server connection swapper **124** receives the composed work packet **123***a* in the Thread n+1 in step **207**, records that unique ID of the composed work packet **123***a*, and wakes up one of the initial internal threads of execution, for example Thread 0, to deliver the composed work packet **123***a* to the front en proxy server internal server **126** at step **208**. When the initial internal thread of execution, Thread 0 in this example, wakes up, the front end proxy server internal server **126** generates, for example, a work response at **209** in response to the initial request for work from step **201**. The work response contains the composed work packet **123***a* composed as part of step **207**. The work response at **209** may be a HTTP response to the initial request for work **201** HTTP request. The front end proxy server internal server **126** submits, for example, the work response containing work packet **123***a* to the back end proxy client internal client **133** as part of step **209**. The work request submitted at **209** thus includes the client server request A.

In a fairly high traffic implementation, new requests for service sometimes arrive before earlier service requests are fully serviced. To illustrate by way of example, at about the same time, the front end proxy server external server **122** receives another request B for service from the client **111** or elsewhere on the external network **110** at **212**. The additional request B, for example, may be a request for another web page provided by target server **132**. The front end proxy server external server **122** composes another work packet **123***b* containing service request B, generates another thread of execution (Thread n+2), and submits the other composed work packet **123***b* to the front end proxy server connection swapper **124** at step **213**. The front end proxy server connection swapper **124**, in such an example, records the unique ID of the other composed work packet **123***b* and wakes the other initial internal thread of execution (Thread n) to deliver the other composed work packet **123***b* to the front end proxy server internal server **126** at step **214**. When the other initial internal thread of execution, Thread n in this example, wakes up, the front end proxy server internal server **126** generates, for example, a work response at step **215** in response to the initial request for work **203**. The work response contains the other composed work packet **123***b* composed as part of step **213**. The work response submitted at step **216** thus includes the client service request B. Alternatively, as discussed below, the other composed work packet **123***b* and/or subsequent composed work packet(s) **123***a*, **123***b* may be delivered to the back end proxy client internal client **133** as a work response (not shown) to a subsequent work request, such as the work request generated in step **227**, for example.

Returning to the flow relative to the original work response generated by the front end proxy server internal server **126** at step **209**, the back end prosy client internal client **133** receives the work response, records the composed work packet **123***a*, and decomposes the work packet **123***a* resulting in the original request A **134***a* at step **210**. The back end proxy client internal client **133** also passes the service request A to the back end proxy client external client **135** as part of step **210** and the back end proxy client external client **135** then submits the service request A to the target server **132** at step **211**.

In a similar fashion, the back end proxy client internal client **133** receives the work response containing the other composed work packet **123***b* generated at step **215**, records the other composed work packet **123***b* unique ID, and decomposes the other work packet **123***b* resulting in the original service request B **134***b* at step **216**. The back end proxy client internal client **133** then also passes the original service request B to the back end proxy client external client **135** as part of step **216** and the back end proxy client external client **135** submits the service request B to the target server **132** at step **217**.

The service processing **138** by the target server **132** is dependent on various factors of the service that target server **132** is configured to offer; and the service processing **138** and the operations of the system **100** need not be particularly dependent on or limited by each other except with regard to the flow of communications outlined by way of example here. It is assumed for this example that service processing **138** may result in a service response B prior to a service response A, but this is not necessarily always the case. The target server performs service processing **138** and returns a service response B to the back end proxy client external client **135** at step **218**. In the web request example, the service response B may be the requested web page of content. The target server also performs service processing **138** and returns a service response A to the back end proxy client external client **135** at step **225**. For example, the original client service request A may be an HTTP request for a web page, the service processing **138** may be a web server, and the service response A may be the web page as an HTTP response.

The back end proxy client external client **135** receives the service response B and composes a new work packet **136***b* by encapsulating the service response B from the target server **132** at step **219**. The back end proxy client external client **135** also receives the service response A and composes another work packet **136***a* by encapsulating the service response A from the target server **132** at step **226**.

The new composed work packet **136***b* contains, for example, the unique ID recorded from the composed work packet **123***b* and a work packet version number. That is, the new work packet **136***b* corresponds, for example, to the received work packet **123***b*. The unique ID correlates the work response to a work request so that the work response may be identified by the front end proxy server connection swapper **124**, as described in further detail below. The new composed work packet **136***a* also contains a mode indicating the contents of the new composed work packet **136***b*. The mode may be, for example, one of: empty, request, response, keepalive, heartbeat, or DirectData. The new composed work packet **136***b* also contains various properties of the service replay from the target server **132** including the HTTP response version, code and status; HTTP headers and parameters; and the service response B itself.

The back end proxy client internal client **133** then generates a new request for work containing the new composed work packet **136***b* and submits the new request for work to the front end proxy server internal server **126** at step **220**. The back end proxy client internal client **133** also generates another new request for work containing the other composed work packet **136***a* and submits the other new request for work to the front end proxy server internal server **126** at step **227**.

That is, service responses A, B from a target server **132** to existing client service requests A, B are passed from the back end proxy client internal client **133** to the front end proxy server internal server **126** as a new request for work in steps **220**, **227**. As a further example, the back end proxy client internal client **133** may generate new HTTP requests that are new requests for work and also contain the web pages, from prior examples, as HTTP responses encapsulated within the new composed work packets **136***a*, **136***b*, at steps **220**, **227**.

Although not shown in FIG. **2**, in response to the new requests for work in steps **220**, **227**, the front end proxy server internal server **126** may, for example, submit subsequent composed work packets **123***a*, **123***b* from the initial internal threads of execution **202**, **204** to the back end proxy client internal client **133**. That is, subsequent client service requests are passed from the front end proxy server internal server **126** to the back end proxy client internal client **133** as work responses to existing requests for work, such as the work requests generated in steps **220**, **227**. In addition, the front end proxy server internal server **126** in this example may also submit the composed work packets **136***a*, **136***b* encapsulating the responses from the target server **132** contained in the new request for work generated in steps **220**, **227** to the front end proxy server connection swapper **124** in the initial internal threads of execution (Thread 0 and Thread n).

It may be, for example, that the back end proxy client internal client **133** submits a subsequent request for work to the front end proxy server internal server **126** with a subsequent composed work packet **136***a* encapsulating a subsequent service response B from the target server **132** corresponding to a subsequent client request for service B before the front end proxy server internal server **126** receives the new composed work packet **136***a* corresponding to the initial client request A for service. That is, step **220** relates to a service response B and step **227** relates to service response A, even though service request A was received at step **209** before service request B was received at step **215**. In such a case, the front end proxy server internal server **126** may, for example, submit the subsequent composed work packet **136***b* containing the service response B to the front end proxy server connection swapper **124** in Thread 0 even though Thread 0 did not deliver the composed work packet **123***b* containing the service request B from the front end proxy server connection swapper **124** to the front end proxy server internal server **126**. That is, the initial threads of execution, Thread 0 and Thread n, may be used to exchange composed work packets **123***a*, **123***b* and composed work packets **136***a*, **136***b* between the front end proxy server internal server **126** and the front end proxy server connection swapper **124** that do not necessarily correspond to a correlated request for service and response to that request for service.

Returning to the examples, upon receipt of the new composed work packet **136***b* in the work request generated at step **220**, the front end proxy server internal server **126** delivers the composed work packet **136***b* to the front end proxy server connection swapper **124** at step **221** via Thread 0. Thread 0 then returns to sleep and awaits another service request at step **222**. In a similar fashion, upon receipt of the other composed work packet **136***a* in the work request generated at step **227**, the front end proxy server internal server **126** also delivers the other composed work packet **136***a* to the front end proxy server connection swapper **124** at step **228** via Thread n. Thread n then also returns to sleep and awaits another service request at step **299**.

The front end proxy server connection swapper **124** decomposes the work packet **136***b* at step **223**, resulting in the original service response B **125***b*. As part of step **223**, the front end proxy server connection swapper **124** also compares the composed work packet **136***b* unique ID with recorded unique IDs from composed work packets **123***a*, **123***b* to determine the appropriate thread of execution, Thread n+2 in this example, in which to submit the response B from the target server **132** to the front end proxy server external server **122**. Likewise, the front end proxy server connection swapper **124** also decomposes the work packet **136***a* at step **230**, resulting in the original service response A **125***a*. As part of step **230**, the front end proxy server connection swapper **124** also compares the composed work packet **136***a* unique ID with recorded unique IDs from composed work packets **123***a*, **123***b* to determine the appropriate thread of execution, Thread n+1 in this example, in which to submit the response A from the target server **132** to the front end proxy server external server **122**. That is, the front end proxy server connection swapper **124** utilizes, for example, the work packet unique ID of the new composed work packets **136***a*, **136***b* to determine a thread of execution. Thread n+1 or Thread n+2, that corresponds to a correlated request for service and response to the request for service such that the corresponding service response is returned to the appropriate user client **111**.

Hence, FIGS. **1-2** and the corresponding descriptions above explain examples of an isolation proxy server system **100** and operation of such a system **100**. The front end proxy server external server **122** only receives requests for a service provided by the target server **132** from a client like user client **111** on the external network **110**; and the front end proxy server internal server **126** only receives requests for work from the back end proxy client internal client **133**. The front end proxy server internal server **126** forwards the received client requests for services provided by the target server **132** encapsulated in composed work packets **123***a*, **123***b* to the back end proxy client internal client **133** as work responses to requests for work originated by back end proxy client internal client **133**. With the exception of the initial requests for work, subsequent requests for work from back end proxy client internal client **133** to front end proxy server internal server **126** may, whenever practical, carry composed work packets **136***a*, **136***b* encapsulating service responses from the target server **132**. The front end proxy server connection swapper **124** maps composed work packets **136***a*, **136***b* encapsulating service responses form the target server **132** received by the front end proxy server internal server **126** from the back end proxy client internal client **133** with composed work packets **123***a*, **123***b* encapsulating service requests from client **111** so that the front end proxy server external server **122** may then delivery the correct service response to the client **111**.

In a similar fashion, the back end proxy client internal client **133** only originates requests for work to the front end proxy server internal server **126** and receives client requests for services provided by the target server **132** from the front end proxy server internal server **126** encapsulated in composed work packets **123***a*, **123***b* as responses to the requests for work. In addition, the back end proxy client external server **135** only originates requests for service to the target server **132** based on the client requests for services provided by the target server **132** encapsulated in the composed work packets **123***a*, **123***b* and only receives service responses from the target server **132** corresponding to the client requests for services provided by the target server **132**. The back end proxy client external server **135** composes work packets **136***a*, **136***b* encapsulating the service responses from the target server **132** corresponding to the client requests for services provided by the target server **132**. The back end proxy client internal client **133** then forwards the composed work packets **136***a*, **136***b* encapsulating the service responses from the target server **132** corresponding to the client requests for services provided by the target server **132** to the front end proxy server internal server **126** in the requests for work.

As outlined above, isolation proxy server system **100** functions may be implemented by configuration of computer platforms as in the front end proxy server **121**, the back end proxy client **131** and the target server **132** as well as the client **111**. Such configuration typically entails programming for the processors. We have discussed examples of the various elements **121**, **131**, and **132**, however, it may be helpful to briefly consider programmable computers, e.g. for server operations and/or for other types of end user or terminal devices.

FIGS. **3** and **4** provide functional block diagram illustrations of general purpose computer hardware platforms. FIG. **3** illustrates a network or host computer platform, as may typically be used to implement a server. FIG. **4** depicts a computer with user interface elements, as may be used to implement a personal computer or other type of work station or terminal device, although the computer of FIG. **4** may also act as a server if appropriately programmed. It is believed that the general structure and general operation of such equipment as shown in FIGS. **3** and **4** should be self-explanatory from the high-level illustrations.

A server, for example, includes a data communication interface for packet data communication. The server also includes a central processing unit (CPU), in the form of one or more processors, for executing program instructions. The server platform typically includes an internal communication bus, program storage and data storage for various data files to be processed and/or communicated by the server, although the server often receives programming and at a via network communications. The hardware elements, operating systems and programming languages of such servers are conventional in nature. Of course, the server functions may be implemented in a distributed fashion on a number of similar platforms, to distribute the processing load.

A computer type user terminal device, such as a PC or tablet computer, similarly includes a data communication interface CPU, main memory and one or more mass storage devices for storing user data and the various executable programs (see FIG. **4**). A mobile device type user terminal may include similar elements, but will typically use smaller components that also require less power, to facilitate implementation in a portable form factor. The various types of user terminal devices will also include various user input and output elements. A computer, for example, may include a keyboard and a cursor control/selection device such as a mouse, trackball, joystick or touchpad; and a display for visual outputs. A microphone and speaker enable audio input and output. Some smartphones include similar but smaller input and output elements. Tablets and other types of smartphones utilize touch sensitive display screens, instead of separate keyboard and cursor control elements. The hardware elements, operating systems and programming languages of such user terminal devices also are conventional in nature.

Hence, aspects of the methods of the isolation proxy server system outlined above may be embodied in programming. Program aspects of the technology may be thought of as "products" or "articles of manufacture" typically in the form of executable code and/or associated data that is carried on or embodied in a type of machine readable medium. "Storage" type media include any or all of the tangle memory of the computers, processors or the like, or associated modules thereof, such a various semiconductor memories, tape drives, disk drives and the like, which may provide non-transitory storage at any time for the software programming. All or portions of the software may at times be communicated through the Internet or various other telecommunications networks. Such communications, for example, may enable loading of the software from one computer or processor into another, for example, from a management server or host computer of a service provider into the computer platform of the isolation proxy server system that will be the front end proxy server and/or back end proxy client. Thus, another type of media that may bear the software elements includes optical, electrical and electromagnetic waves, such as used across physical interfaces between local devices, through wired and optical and landline networks and over various airlinks. The physical elements that carry such waves, such as wired or wireless links, optical links or the like, also may be considered as media bearing the software. As used herein, unless restricted to non-transitory, tangible "storage" media, terms such as computer or machine "readable medium" refer to any medium that participates in providing instructions to a processor for execution.

Hence, a machine readable medium may take many forms, including but not limited to, a tangible storage medium, a carrier wave medium or physical transmission medium. Non-volatile storage media include, for example, optical or magnetic disks, such as any of the storage devices in any computer(s) or the like, such as may be used to implement the DIPS front end proxy server, etc. shown in the drawings. Volatile storage media include dynamic memory, such as main memory of such a computer platform. Tangible transmission media include coaxial cables; copper wire and fiber optics, including the wires that comprise a bus within a computer system. Carrier-wave transmission media can take the form of electric or electromagnetic signals, or acoustic or light waves such as those generated during radio frequency (RF) and infrared (IR) data communications. Common forms of computer-readable media therefore include for example: a floppy disk, a flexible disk, hard disk, magnetic tape, any other magnetic medium, a CD-ROM, DVD or DVD-ROM, any other optical medium, punch cards paper tape, any other physical storage medium with patterns of holes, a RAM, a PROM and EPROM, a FLASH-EPROM, any other memory chip or cartridge, a carrier wave transporting data or instructions, cables or links transporting such a carrier wave, or any other medium from which a computer can read programming code and/or data. Many of these forms of computer readable media may be involved in carrying one or more sequences of one or more instructions to a processor for execution.

While the foregoing has described what are considered to be the best mode and/or other examples, it is understood that various modifications may be made therein and that the subject matter disclosed herein may be implemented in various forms and examples, and that the teachings may be applied in numerous applications, only some of which have been described therein. It is intended by the flowing claims to claim any and all applications, modifications and variations that fall within the true scope of the present teachings.

Unless otherwise states, all measurements, values, ratings, positions, magnitudes, sizes, and other specifications that are set forth in this specification, including in the claims that follow, are approximate, not exact. They are intended to have a reasonable range that is consistent with the functions to which they relate and with what is customary in the art to which they pertain.

The scope of protection is limited solely by the claims that follow. That scope is intended and should be interpreted to be as broad as is consistent with the ordinary meaning of the language that is used in the claims when interpreted in light of this specification and the prosecution history that follows and to encompass all structural and functional equivalents. Notwithstanding, none of the claims are intended to embrace subject matter that fails to satisfy the requirement of Sections 101, 102, or 103 of the Patent Act, nor should they be interpreted in such a way. Any unintended embracement of such subject matter is hereby disclaimed.

Except as stated immediately above, nothing that has been stated or illustrated in intended or should be interpreted to cause a dedication of any component, step, feature, object, benefit, advantage, or equivalent to the public, regardless of whether it is or is not recited in the claims.

It will be understood that the terms and expressions used herein have the ordinary meaning as is accorded to such terms and expressions with respect to their corresponding respective areas of inquiry and study except where specific meanings have otherwise been set forth herein. Relational terms such as first and second and the like may be used solely to distinguish one entity or action from another without necessarily requiring or implying any actual such relationship or order between such entities or actions. The terms "comprises," "comprising," or any other variation thereof, are intended to cover a non-exclusive inclusion, such that a process, method, article, or apparatus that comprises a list of elements does not include only those elements but may include other elements not expressly listed or inherent to such process, method, article, or apparatus. An element proceeded by "a" or "an" does not, without further constraints, preclude the existence of additional identical elements in the process, method, article, or apparatus that comprises the element.

The Abstract of the Disclosure is provided to allow the reader to quickly ascertain the nature of the technical disclosure. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. In addition, in the foregoing Detailed Description, it can be seen that various features are grouped together in various embodiments for the purpose of streamlining the disclosure. This method of disclosure is not to be interpreted as reflecting an intention that the claimed embodiments require more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive subject matter lies in less than all features of a single disclosed embodiment. Thus the following claims are hereby incorporated into the Detailed Description, with each claim standing on its own as a separately claimed subject matter.

What is claimed is:

1. A computer, comprising:

a processor configured to control operations of the computer;

a memory; and

a front end proxy server program in the memory comprising:

an internal server program object;

an external server program object; and

a connection swapper program object,

wherein:

execution of the front end proxy server internal server program object by the processor of the computer configures the computer to implement functions, including functions to:

(I) establish first threads of execution, wherein:

each first thread of execution is in response to a respective request for work from a back end proxy client internal client program object executing on a computer platform configured as a back end proxy client; and

each first thread of execution sleeps while waiting to receive a request for a service provided by a target server from a user client to the front end proxy server external server program object;

(II) receive, by one of the first threads of execution and from the front end proxy server connection swapper program object, the request for the service received from the user client;

(III) forward, by the one of the first threads of execution and contained in a response to the respective request for work from the back end proxy client internal client program object, the request for the service received from the user client; and

(IV) send, by another one of the first threads of execution and to the front end proxy server connection swapper program object, a response from the target server to the request for the service received from the user client upon receipt of the response from the target server to the request for the service received from the user client contained in another request for work from the back end proxy client internal client program object;

execution of the front end proxy server external server program object by the processor of the computer configures the computer to implement functions, including functions to:

(A) establish a second thread of execution in response to receipt of the request for the service from the user client;

(B) send, by the second thread of execution, the request for the service received from the user client to the front end proxy server connection swapper program object;

(C) receive, by the second thread of execution, the response from the target server to the request for the service received from the user client from the front end proxy server connection swapper program object; and

(D) forward, by the second thread of execution and to the user client, the response from the target server to the request for the service received from the user client; and

execution of the front end proxy server connection swapper program object by the processor of the computer configures the computer to implement functions, including functions to:

(i) associate the second thread of execution established by the front end proxy server external server program object with the one of the first threads of execution in receipt of the request for the service received from the user client and the other one of the first threads of execution sending the response from the target server to the request for the service received from the user client;

(ii) receive, from the second thread of execution established by the front end proxy server external server program object, the request for the service received from the user client;

(iii) send, to the one of the first threads of execution, the request for the service received from the user client;

(iv) receive, from the other one of the first threads of execution, the response from the target server to the request for the service received from the user client; and

(v) send, to the second thread of execution, the response from the target server to the request for the service received from the user client.

2. The computer of claim **1**, wherein the implemented function of the front end proxy server external server program object to send the request for the service received from the user client to the front end proxy server connection swapper program object further includes functions to:

compose a work packet comprising a unique ID, a work packet version number, a mode indicating the contents of the work packet, properties of the request for the service received from the user client, and the body of the request for the service received from the user client,

wherein the composed work packet encapsulates the request for the service received from the user client.

3. The computer of claim **1**, wherein the implemented function of the front end proxy server external server program object to receive the response from the target server to the request for the service received from the user client from the front end proxy server connection swapper program object further includes functions to:

decompose a work packet comprising a unique ID, a work packet version number, a mode indicating the contents of the work packet, properties of the response from the target server to the request for the service received from the user client, and the body of the response from the target server to the request for the service received from the user client,

wherein the work packet encapsulates the response from the target server to the request for the service received from the user client.

4. The computer of claim **1**, wherein the implemented function of the front end proxy server internal server program object to establish the first threads of execution further includes functions to:

establish, in compliance with a configuration file, each first thread of execution in response to the respective request for work from the back end proxy client internal client program object, wherein the configuration file comprises:

a rule to allow or deny the front end proxy server internal server program object to receive the respective request for work from the back end proxy client.

5. The computer of claim **1**, wherein the one of the first threads of execution and the other one of the first threads of execution are a same thread of execution.

6. The computer of claim **1**, wherein the one of first threads of execution and the other one of the first threads of execution are different threads of execution.

7. A non-transitory storage medium storing instructions executable by a device, wherein the instructions comprise instructions to:

execute a front end proxy server internal server program object to:

(I) establish first threads of execution, wherein each first thread of execution is in response to a respective request for work from a back end proxy client internal client program object executing on a computer platform configured as a back end proxy client;

(II) receive, by one of the first threads of execution and from a front end proxy server connection swapper program object, a request for a service received from a user client;

(III) forward, by the one of the first threads of execution and contained in a response to the respective request for work from the back end proxy client internal client program object, the request for the service received from the user client; and

(IV) send, by another one of the first threads of execution and to the front end proxy server connection swapper program object, a response from the target server to the request for the service received from the user client upon receipt of the response from the target server to the request for the service received from the user client contained in another request for work from the back end proxy client internal client program object;

execute the front end proxy server external server program object to:

(A) establish a second thread of execution in response to receipt of the request for the service from the user client;

(B) send, by the second thread of execution, the request for the service received from the user client to the front end proxy server connection swapper program object;

(C) receive, by the second thread of execution, the response from the target server to the request for the service received from the user client from the front end proxy server connection swapper program object; and

(D) forward, by the second thread of execution and to the user client, the response from the target server to the request for the service received from the user client; and

execute the front end proxy server connection swapper program object to:

(i) associate the second thread of execution with the one of the first threads of execution in receipt of the request for the service received from the user client and the other one of the first threads of execution sending the response from the target server to the request for the service received from the user client;

(ii) receive, from the second thread of execution, the request for the service received from the user client;

(iii) send, to the one of the first threads of execution, the request for the service received from the user client;

(iv) receive, from the other one of the first threads of execution, the response from the target server to the request for the service received from the user client; and

(v) send, to the second thread of execution, the response from the target server to the request for the service received from the user client.

8. The non-transitory storage medium of claim **7**, wherein the instructions to send the request for the service received from the user client to the front end proxy server connection swapper program object further comprise instructions to:

compose a work packet comprising a unique ID, a work packet version number, a mode indicating the contents of the work packet, properties of the request for the service received from the user client, and the body of the request for the service received from the user client,

wherein the composed work packet encapsulates the request for the service received from the user client.

9. The non-transitory storage medium of claim **7**, wherein the instructions to receive the response from the target server to the request for the service received from the user client from the front end proxy server connection swapper program object further comprise instructions to:

decompose a work packet comprising a unique ID, a work packet version number, a mode indicating the contents of the work packet, properties of the response from the target server to the request for the service received from the user client, and the body of the response from the target server to the request for the service received from the user client,

wherein the work packet encapsulates the response from the target server to the request for the service received from the user client.

10. The non-transitory storage medium of claim **7**, wherein the instructions to establish the first threads of execution further comprise instructions to:

establish, in compliance with a configuration file, each first thread of execution in response to the respective request for work from the back end proxy client internal client program object, wherein the configuration file comprises:

a rule to allow or deny the front end proxy server internal server program object to receive the respective request for work from the back end proxy client.

11. The non-transitory storage medium of claim **7**, wherein the one of the first threads of execution and the other one of the first threads of execution are a same thread of execution.

12. The non-transitory storage medium of claim **7**, wherein the one of the first threads of execution and the other one of the first threads of execution are different threads of execution.

13. The non-transitory storage medium of claim **7**, wherein to establish the first threads of execution, each first thread of execution sleeps while waiting to receive the request for the service provided by a target server from the user client to a front end proxy server external server program object.

14. A method performed by a device, the method comprising:

executing a front end proxy server internal server program object to:

(I) establish first threads of execution, wherein each first thread of execution is in response to a respective request for work from a back end proxy client internal client program object executing on a computer platform configured as a back end proxy client;

(II) receive, by one of the first threads of execution and from a front end proxy server connection swapper program object, a request for a service received from a user client;

(III) forward, by the one of the first threads of execution and contained in a response to the respective request for work from the back end proxy client internal client program object, the request for the service received from the user client; and

(IV) send, by another one of the first threads of execution and to the front end proxy server connection swapper program object, a response from the target server to the request for the service received from the user client upon receipt of the response from the target server to the request for the service received from the user client contained in another request for work from the back end proxy client internal client program object;

executing the front end proxy server external server program object to:

(A) establish a second thread of execution in response to receipt of the request for the service from the user client;

(B) send, by the second thread of execution, the request for the service received from the user client to the front end proxy server connection swapper program object;

(C) receive, by the second thread of execution, the response from the target server to the request for the service received from the user client from the front end proxy server connection swapper program object; and

(D) forward, by the second thread of execution and to the user client, the response from the target server to the request for the service received from the user client; and

executing the front end proxy server connection swapper program object to:

(i) associate the second thread of execution with the one of the first threads of execution in receipt of the request for the service received from the user client and the other one of the first threads of execution sending the response from the target server to the request for the service received from the user client;

(ii) receive, from the second thread of execution, the request for the service received from the user client;

(iii) send, to the one of the first threads of execution, the request for the service received from the user client;

(iv) receive, from the other one of the first threads of execution, the response from the target server to the request for the service received from the user client; and

(v) send, to the second thread of execution, the response from the target server to the request for the service received from the user client.

15. The method of claim **14**, wherein to send the request for the service received from the user client to the front end proxy server connection swapper program object, the instructions further to:

compose a work packet comprising a unique ID, a work packet version number, a mode indicating the contents of the work packet, properties of the request for the service received from the user client, and the body of the request for the service received from the user client,

wherein the composed work packet encapsulates the request for the service received from the user client.

16. The method of claim **14**, wherein to receive the response from the target server to the request for the service received from the user client from the front end proxy server connection swapper program object the method further comprising:

decomposing a work packet comprising a unique ID, a work packet version number, a mode indicating the contents of the work packet, properties of the response from the target server to the request for the service received from the user client, and the body of the response from the target server to the request for the service received from the user client,

wherein the work packet encapsulates the response from the target server to the request for the service received from the user client.

17. The method of claim **14**, wherein to establish the first threads of execution, the method further comprising:

establishing, in compliance with a configuration file, each first thread of execution in response to the respective request for work from the back end proxy client internal client program object, wherein the configuration file comprises:

a rule to allow or deny the front end proxy server internal server program object to receive the respective request for work from the back end proxy client.

18. The method of claim **14**, wherein the one of the first threads of execution and the other one of the first threads of execution are a same thread of execution.

19. The method of claim **14**, wherein the one of the first threads of execution and the other one of the first threads of execution are different threads of execution.

20. The method of claim **14**, wherein to establish the first threads of execution, each first thread of execution sleeps while waiting to receive the request for the service provided by a target server from the user client to a front end proxy server external server program object.

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